

Valley Clean Air Now (Valley CAN) Tune In & Tune Up Program

**Bakersfield, California
March 28, 2009**

FINAL REPORT

Sponsored by Valley Clean Air Now

**With Assistance from
The Advanced Transportation Technology and Energy Initiative
The Kenneth L. Maddy Institute at California State University, Fresno
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INTRODUCTION

This is the seventh in a series of reports describing the Valley Clean Air Now (Valley CAN) Tune In & Tune Up (TI&TU) Program, which is designed to quickly screen and identify high-emitting vehicles in need of emissions-reduction repairs. Relationships established between Valley CAN, the Advanced Transportation Technology and Energy Initiative (ATTEi), the Foundation for California Community Colleges, and the California Department of Consumer Affairs (DCA) contributed to the program's success.

This report describes the TI&TU event on March 28, 2009 in Bakersfield and summarizes the data collected during that event. With the assistance of media buys on English and Spanish radio stations and a comprehensive grassroots outreach campaign, a total of 457 vehicle owners volunteered to have their vehicles tested during the Bakersfield event.

During the Bakersfield event, vehicles were given a tailpipe emissions test using a hand-held portable emission testing device, performed by staff from DCA. Participating vehicles were tested for exhaust hydrocarbons (HC) and carbon monoxide (CO) during the two-speed idle test using the AutoLogic Model 310-0121 gas analyzer. Because the vehicles were tested under idle conditions, no measurements of nitrogen oxides (NO_x) were made during the TI&TU event. If the vehicle failed any of the two-speed idle cutpoints for HC or CO exhaust emissions or a quick visual inspection for tampering or illumination of the check engine light by DCA staff, the vehicle was judged to be eligible to enter the Valley CAN vehicle repair program.

TI&TU program staff provided repair vouchers worth up to \$500 in emission-related repair costs to the participants that failed the screening test. Data from the TI&TU event are shown in Table 1. Of the 457 vehicles tested, 391 qualified for the repair portion of the program. Two hundred ninety-eight vehicles actually began the repair program. Vehicle repairs were performed at Rosedale Automotive, Superior Automotive Services, and Wheels Automotive Repair and Smog, which are Gold Shield-certified smog shops in the Bakersfield area.

If an inspected vehicle failed either the tailpipe emissions test or visual inspection, the vehicle's owner was directed to an on-site diagnostic testing station at the event where Bakersfield City College automotive students, supervised by their instructors, performed a basic underhood visual inspection and provided written information regarding possible causes of the vehicle's emission problems. This event provided a career technical education opportunity as each student had the opportunity to assess dozens of cars with a wide variety of potential problems.

To summarize, the vehicles went through the following process:

- Arrive at the event and queue up to await testing
- Proceed to the emissions testing station, where DCA staff performs a two-speed idle emissions test with a portable gas analyzer.
- Continue to the under-hood diagnostics station, where automotive students perform a basic visual inspection.
- If the vehicle fails the on-site inspection or emissions test, the owner schedules an appointment with the test-and-repair shop before leaving the event.

Emissions benefits generated by the Tune In & Tune Up program are not included in the Smog Check baseline credits for emissions or in state implementation plan (SIP) calculations.

This report describes only the tailpipe emissions reductions measured from this set of vehicles, and may not be a sample representative of the on-road fleet. Results might vary due to different methods of emission reduction calculations.

Table 1. Tune In & Tune Up Event Data

Location/Date	Vehicles Tested	Coupons Distributed/ Redeemed	Percent Redeemed	Valley CAN Inspection/Repair Costs	Customer-Paid Costs	Total Repair Costs
Bakersfield, March 28, 2009	457	391/298	76%	\$98,869	\$22,454	\$121,323

The following sections describe data collected and emission reductions obtained in the 2009 Bakersfield Tune In & Tune Up event.

VEHICLE REPAIR DATA

Two hundred ninety-eight vehicles began the repair program, where vehicles were first given a initial, confirmatory California Smog Check test and inspection at the Gold Shield certified smog shops (Rosedale Automotive, Superior Automotive Services, and Wheels Automotive Repair and Smog). There were several potential outcomes from all the vehicles that participated, as shown in Figure 1.

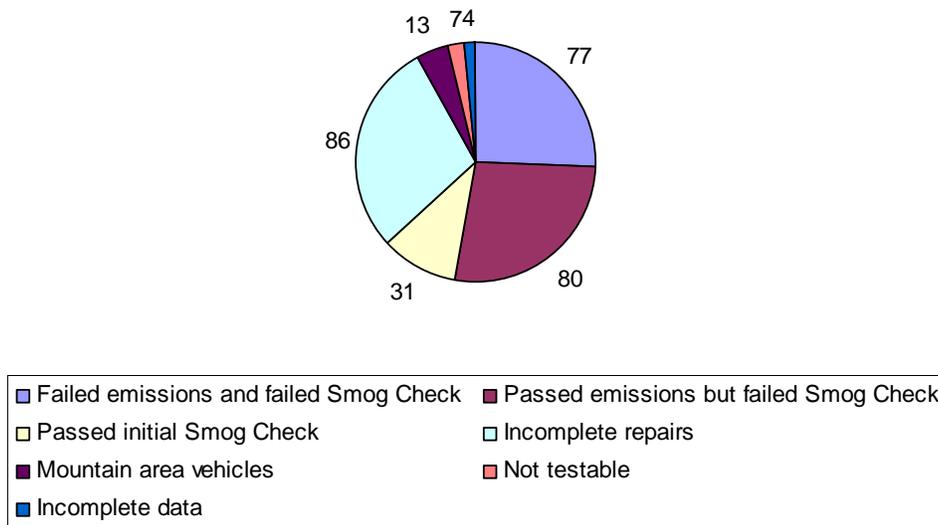


Figure 1. Number of vehicles categorized by emissions testing outcomes.

A total of 157 vehicles were successfully repaired according to Smog Check inspection standards and emissions cutpoints. Forty-nine percent, or 77 of the vehicles that failed the initial emissions screening test at the TI&TU event also failed the initial ASM emissions tests at the repair shops.

Fifty-one percent or 80 vehicles passed the ASM emissions portion of the Smog Check at the repair shops but failed the Smog Check inspection because of other reasons. This variance is due to the variability of emissions levels from malfunctioning vehicles, the at-event screening and Smog Check testing being done with different types of equipment, and different pass/fail emissions cutpoints between the event screening and the ASM emissions criteria in the Smog Check program. Twenty-nine percent of the vehicles that entered the repair program (a total of 86) left the TI&TU Program before complete repairs were made, with the majority of those owners not wanting to spend their own money on repairs costing more than the \$500 repair voucher provided by the Valley CAN Program. Four percent of the vehicles were registered outside the program areas, and did not require NOx-related emission repairs. Seven of the vehicles were in such poor condition that the repair shops did not feel that they were repairable, and there were incomplete repair/emissions data for another four vehicles.

The model year distribution of all vehicles participating in the program is shown in Figure 2. Vehicles were given both emissions tests used in the enhanced Smog Check program, the ASM5015 and the ASM2525, which are steady-state loaded mode tests conducted on a dynamometer. All vehicles in the “Passed ASM Emissions” and “Failed ASM Emissions” categories were successfully repaired according to Smog Check program criteria. The average and median model year of all vehicles participating in the program were 1994 and 1995, respectively. The newest model year vehicles in the program that failed the initial Smog Check inspection tended to fail more for other reasons than the ASM emission cutpoints, as shown in Figure 2. Table 2 provides the status of the vehicles that entered the repair program and their average repair costs in the 2009 Bakersfield event.

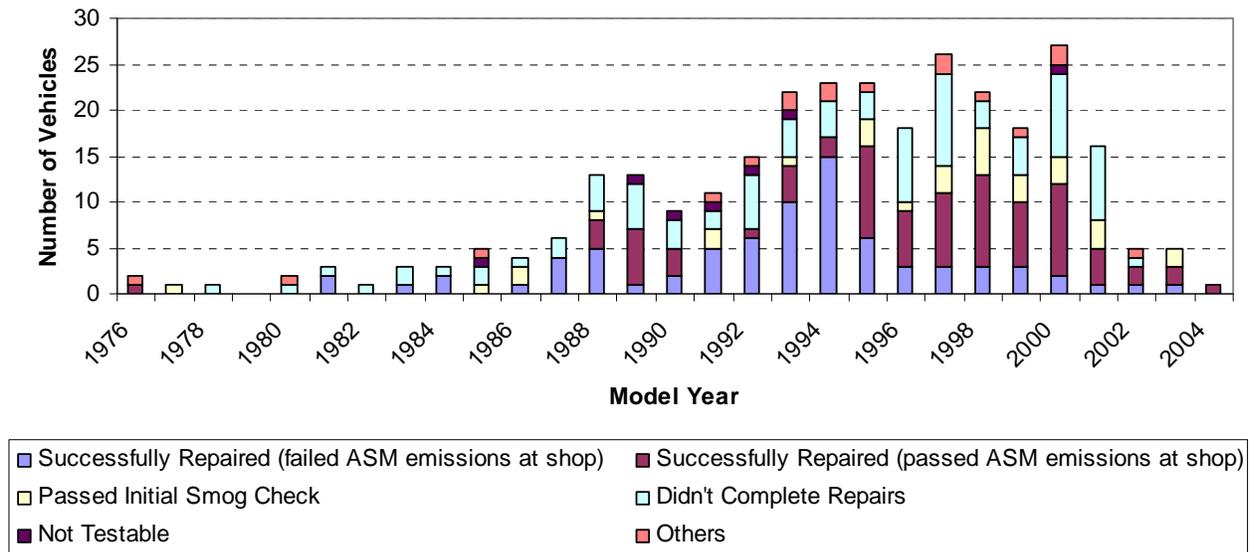


Figure 2. Model year distribution of the vehicles participating in the 2009 Bakersfield TI&TU Event.

Table 2. Status of vehicles that entered the 2009 Bakersfield TI&TU Repair Program Event.

Vehicle Category	Average Repair/Diagnosis Cost/Vehicle
Successfully repaired, n = 157	\$547
Failed ASM Emissions and Repaired, n = 77	\$576
Passed ASM Emissions and Repaired, n = 80	\$519
Incomplete Repairs, n = 86	\$251
No NOx requirements, n = 13	\$519
Not testable, n = 7	\$161
Incomplete Data, n = 4	\$796
Vehicle passed initial Smog Check = 31	\$89

The average repair and inspection cost for all the successfully-repaired vehicles was \$547; the minimum cost was \$90, and the maximum repair cost was \$1205. Repair expenses exceeded the \$500 voucher amount for 77 of the 298 vehicles. An additional 86 vehicles were partially repaired, but for a number of reasons, their repairs were not completed according to Smog Check criteria. The average cost of partial repairs for this group was \$251. Thirteen additional vehicles were repaired according to Smog Check criteria, but because they were registered outside the four cities, there were no Smog Check emission standards for nitrogen oxides (NOx); the data for this group of vehicles are incomplete and/or questionable in some cases. Seven vehicles were in such bad state of maintenance that they were judged by the repairs shops as not testable. Thirty-one, or 10% of the vehicles that failed the event emissions and visual inspection during the Bakersfield TI&TU event, passed the initial Smog Check inspection at the repair shops.

SMOG CHECK EMISSION REDUCTIONS

Table 3 summarizes the pre- and post-ASM emissions data for the 157 vehicles that were successfully repaired according to Smog Check criteria. The values shown in the table are the average of the ASM5015 and ASM2525 emission tests. Based on the results of this 157 vehicle sample, emission reductions of 87%, 73%, and 75% were achieved for CO, HC, and NOx, respectively, for the successfully-repaired group of vehicles. Again, these results are specific to this vehicle sample (many of which are unregistered) and should not be extrapolated statewide without further analysis.

Table 3. Pre- and post-repair emissions data for the 2009 Bakersfield TI&TU vehicles.

Vehicle Class	Ave. Before-Repair ASM Emissions			Ave. After-Repair ASM Emissions		
	CO, %	HC, ppm	NOx, ppm	CO, %	HC, ppm	NOx, ppm
Successfully repaired, n = 157	0.70	104	530	0.09	28	135
Failed ASM Emissions and Repaired, n = 77	1.30	157	866	0.11	36	166
Passed ASM Emissions and Repaired, n = 80	0.10	52	195	0.07	21	104
Partial repairs/Left program, n = 86	1.66	190	611	--	--	--
No NOx requirements, n = 13*	0.33	57	--	--	--	--
Not testable, n = 7	--	--	--	--	--	--

*Data incomplete and/or questionable for these vehicles.

Also shown above are pre-repair average ASM readings for the vehicles in each subgroup, where emissions data were available. Notable are the higher average pre-repair emissions for the 86 vehicles for which the motorists chose not to participate fully in the TI&TU repair event, as compared with the average emissions for the vehicles that were successfully repaired. Had these vehicles been repaired according to Smog Check criteria, the total emission reductions obtained in the program would have been significantly larger.

Figure 2 illustrates the average pre- and post-repair ASM emissions for the 77 vehicles that failed the pre-repair ASM emissions tests and were later successfully repaired according to Smog Check inspection and emissions standards, resulting in average ASM emission reductions for these events of 91, 77, and 81% for CO, HC, and NOx, respectively.

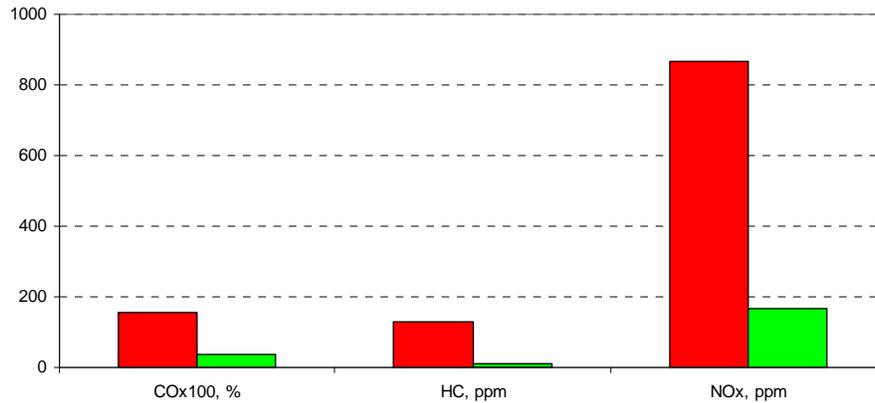


Figure 2. Pre- and post-repair average ASM emissions for the successfully-repaired 77 vehicles that failed the pre-repair ASM emission tests during the 2009 Bakersfield event.

Figure 3 displays the average pre- and post-repair ASM emissions for the 80 vehicles that passed the pre-repair ASM emissions tests and were later successfully repaired according to Smog Check criteria, resulting in an average ASM emission reductions of 31, 48, and 47% for CO, HC and NOx, respectively. Note that the vertical emissions scale in Figure 3 is the same as that in Figure 2 for comparison purposes.

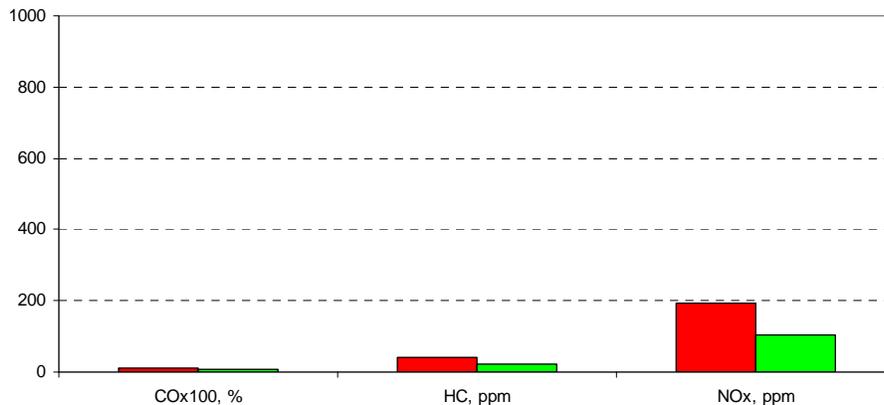


Figure 3. Pre- and post-repair average ASM emissions for the successfully-repaired 80 vehicles that initially passed the pre-repair ASM emission tests during the 2009 Bakersfield event.

Table 3 and Figures 2 and 3 show that the vehicles that passed the pre-repair ASM emission tests, although they failed the initial Smog Check inspection, had much lower initial emissions and smaller absolute and percentage emission reductions after successful repairs than the vehicles that initially failed the emissions portion at the Smog Check repair shops.

COMPARISON WITH THE 1995 CALIFORNIA I/M PILOT PROGRAM

In 1995, the California Air Resources Board tested a set of more than 600 vehicles using the Federal Test Procedure (FTP), IM240, ASM 5015, ASM2525, and two-speed idle tests using the BAR90 analyzer. In that unique study, the vehicles that failed the IM240 or the ASM test were repaired according to emissions criteria using the test that they failed. BAR-employed technicians repaired the failing vehicles, and their pre- and post-repair emissions data were collected at State of California-operated facilities. The California I/M Pilot Study provided the maximum possible repair benefit obtainable in an inspection and maintenance (I/M) program, as the mechanics were employed by the State, and their performance was monitored in a centralized I/M program format with no owner intervention. The emissions reductions obtained in the Valley CAN 2009 Bakersfield TI&TU event are compared with results from the previous TI&TU programs and those obtained during the California Pilot Program in Table 4.

Table 4. Pre- and post-repair emissions data from the 2009 Bakersfield TI&TU event and previous TI&TU Programs, and the 1995 California I/M Pilot Program.

Program	Pre-/Post-Repair Ave. ASM Emissions			Percent Reduction		
	CO, %	HC, ppm	NOx, ppm	CO	HC	NOx
Fresno TI&TU 2005	1.39/0.09	131/46	710/335	94	65	53
Bakersfield TI&TU 2006	1.68/0.27	210/67	923/333	84	69	64
Stockton TI&TU 2006	0.98/0.18	127/51	666/221	82	60	67
Arvin TI&TU 2007	1.53/0.20	140/57	602/249	87	59	59
2006 Visalia and 2007 Merced, Fresno, and Modesto TI&TU Programs						
Failed Pre-Repair ASM Emissions	1.26/0.13	177/45	972/244	90	75	75
Passed Pre-Repair ASM Emissions	0.12/0.14	40/35	244/171	-10	13	30
Parlier TI&TU 2008						
Failed Pre-Repair ASM Emissions	1.24/0.12	518/48	984/225	90	91	77
Passed Pre-Repair ASM Emissions	0.20/0/13	52/32	302/168	36	39	44
Bakersfield TI&TU 2009						
Failed Pre-Repair ASM Emissions	1.30/0.11	157/36	866/166	91	77	81
Passed Pre-Repair ASM Emissions	0.10/0.07	41/21	195/104	31	48	47
CA I/M Pilot Program 1995	1.36/0.22	160/50	884/419	84	69	52

Although there is a 10-13 year difference and vehicle model years/technologies are different between the Valley CAN and California I/M Pilot programs, comparisons between pre- and post-repair emissions levels, along with percent emission reductions, are quite similar. However, the emission reductions from the vehicles that failed the pre-repair ASM emissions tests from the 2009 Bakersfield TI&TU event described in this report are much larger than those obtained in the government-run California I/M Pilot Program.

COSTS OF EMISSION REDUCTIONS

Using statistical relationships derived from the California I/M Pilot Study, where regression relationships were calculated between ASM emission reductions and corresponding FTP data, it is possible to derive rough approximations of tons/year of emission reductions from this Program. Although there is scatter among the different emission test types regarding emission reduction relationships, we used these statistical relationships to estimate total emission reductions for the 77-vehicle fleet that initially failed the emissions portion of the initial Smog Check inspection at the repair shops, assuming that the repairs are effective for 10,000 miles. Estimated reductions would be different if the duration of repairs differs from the 10,000-mile assumption for repair effectiveness. We did not calculate the emission changes and associated costs for the 80 vehicles that passed the ASM emission tests but failed the initial Smog Check inspection, because the pre-repair emissions for this portion of the successfully-repaired vehicles were very low as compared with the emissions-failing vehicles in the Bakersfield event. These estimates are provided in Table 5. These reductions may be significantly different from those obtained in other programs.

Table 5. Emission reductions from the 77 successfully-repaired vehicles, assuming repair effectiveness for 10,000 miles.

Emission Reductions	CO	HC	NOx
Pounds per vehicle	486	46	29
Pounds from 77 vehicles	37,438	3,536	2,216
Tons from 77 vehicles	18.7	1.77	1.11

The 77 vehicles were repaired according to Smog Check emissions criteria at a total cost of \$44,361, or an average cost of \$576 per vehicle. Because it is not possible to apportion the repair types to specific emission reductions, we can provide two calculations in terms of dollars/ton for the Bakersfield event TI&TU Program effectiveness. If we sum the pollutants CO + HC + NOx, the cost-effectiveness of the program is \$2,054 per ton for exhaust emission reductions. The cost-effectiveness for HC + NOx emissions combined is \$15,425 per ton. These costs also include the cost of the Smog Check inspection. Because Smog Check repairs also include those that reduce evaporative or nontailpipe HC, these costs are upper limit costs for the three pollutants. If evaporative or nontailpipe HC emission reductions had been measured in this program, the true cost-effectiveness values would be less than the ones shown here. Because there was no testing for particulate matter (PM) exhaust emissions, it is not possible to calculate PM emission reductions that were obtained in this program.

The emission reductions obtained from the 80 vehicles that initially passed the ASM emissions testing portion of the Smog Check inspection at the repair shops were very small because the pre-repair emissions were relatively low when compared with the ASM-failing vehicles (Table 3 and Figure 3). Net average CO, HC, and NOx emissions after repairs decreased by only 0.03%, 20 ppm and 91 ppm, respectively, so the dollar-per-ton emission reductions for this portion of the successfully repaired vehicles are much higher, at \$27,040 per ton of HC and NOx combined, than the reductions obtained from the 77 vehicles that initially failed the ASM emission tests prior to repairs.

GROSS-POLLUTING VEHICLES

The Bureau of Automotive Repair has adopted criteria for vehicles tested in the Smog Check Program for determining whether tested vehicles can be categorized as gross high polluters. The gross emitter cutpoints for CO, HC, and NOx differ by vehicle model year groups, with more lenient (higher) emissions cutpoints for older vehicles and tighter (lower) emissions cutpoints for newer model year vehicles. Table 6 summarizes the vehicles identified as gross polluters by testing outcomes from the Bakersfield TI&TU event.

Table 6. Gross-polluting vehicles by vehicle category from the 2009 Bakersfield TI&TU event.

Vehicle Class	Number	Percent
Failed ASM Emissions and Repaired, n = 77	29	38
Passed ASM Emissions and Repaired, n = 80	0	0
Partial repairs/Left program, n = 86	28	33
Not testable, n = 7	Data not available	- - -
All others, n = 48	>1	>2

Gross polluters were identified in each of the categories except those that initially passed the ASM emissions-testing portion of the Smog Check inspection and those that passed the Smog Check inspection at the repair facilities. There were nearly as many gross polluters in the group of vehicles that were partially repaired as there were in the group that failed the ASM emissions test and were successfully repaired. From Table 3, we also observe that the CO and HC emissions of this group were generally higher on average than any of the other vehicle categories, so this is a group that merits further attention regarding potential for emission reductions. It is possible that the “not testable” group of vehicles had a significant number of gross polluters, but there are no emissions data available from this category. Data were incomplete for some of the vehicles in the “all others” category, so the number of gross polluters in this group is a lower-limit value.

REGISTRATION STATUS OF VEHICLES IN 2009 BAKERSFIELD EVENT

We acquired the registration status of vehicles that participated in the 2009 Bakersfield Tune In & Tune Up event. DMV records were not available for all vehicles, as a number of vehicles did not have license plates and some errors were made in recording license plate or vehicle identification numbers for the vehicles that participated at the event. There were DMV registration data available for 273 of the 298 vehicles that began the repair program. Sixty-four percent of the vehicles’ registration had lapsed prior to the Bakersfield Tune In & Tune Up event. Figure 4 displays the registration status of only the vehicles whose expiration date was 360 days before or after the March 9, 2009 event.

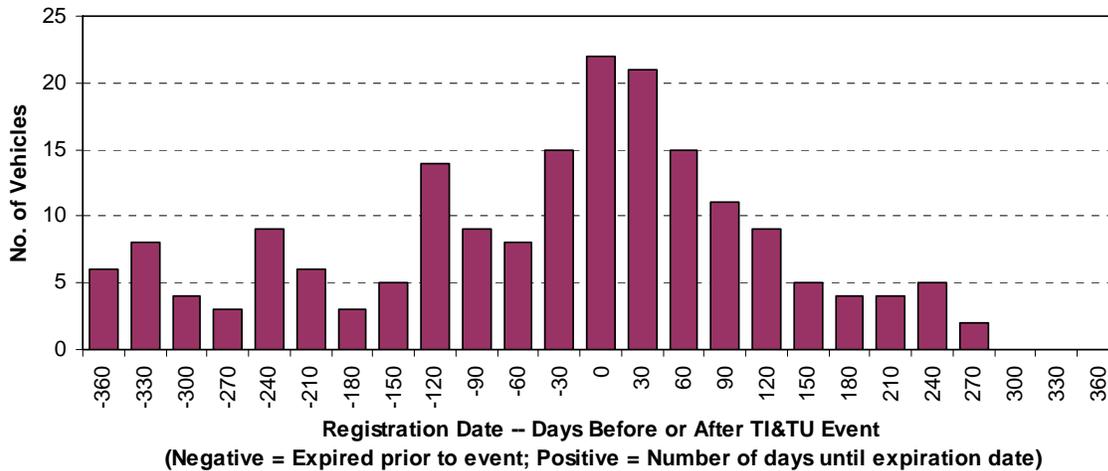


Figure 4. Registration status of vehicles in the 2009 Bakersfield Tune In & Tune Up Event

The vertical bar at 0 days in Figure 4 shows that there were 22 vehicles in the program whose DMV registration would expire within 30 days after the March 9 event. The figure shows that there were 15 vehicles whose registration lapsed 30 days prior to the event. In addition to the vehicles shown in Figure 4, there were 85 vehicles whose registration had expired more than one year prior to the event. One vehicle in the program had not been registered for more than 14 years according to the DMV records.

BAKERSFIELD 2009 TUNE IN & TUNE UP EVENT PARTICIPANTS

The following demographic data were compiled for those who participated in the Bakersfield Tune In & Tune Up event. Figure 5 is a map of the Bakersfield area with three sets of information. The dots show the residence of participants; the color shadings give the average household income by census tract, and the legend provides the participant totals by average income range. Although outreach for the program focused on the Bakersfield area and most participants were from the immediate area, there were some participants from as far as Delano, about 35 miles from Bakersfield. In addition, 92% of the Event participants for whom data were available live in census tracts that averaged less than \$50,000 annual income in the 2000 census.

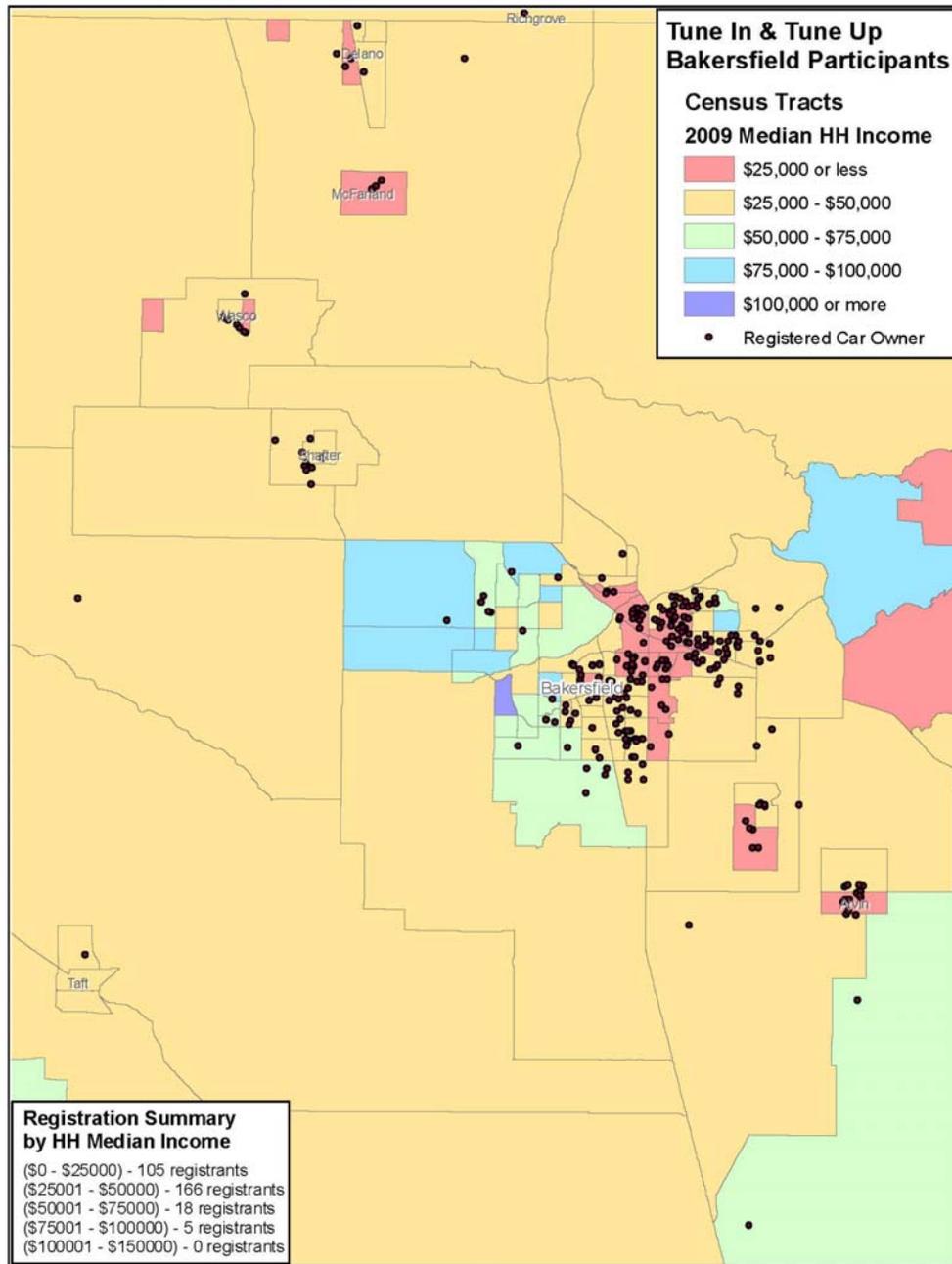


Figure 5. Location, census tract average household incomes, and incomes of participants in the 2009 Bakersfield Tune In & Tune Up Program.

SUMMARY

The Bakersfield 2009 Tune In & Tune Up event was successfully conducted on March 28, 2009. There were 457 motorists who brought their vehicles to the event to participate in the Program. Eighty-six percent (391) of those who came to the event qualified for the repair voucher at the three smog shops for repairs, but only 298 actually entered the repair program. The total spent on Smog Check inspections and repairs for the Bakersfield event was \$121,323, with \$22,454 of that amount spent on repairs directly by vehicle owners.

There were 157 vehicles that were successfully repaired according to Smog Check program criteria, at an average cost of \$547 per vehicle. One-half of the vehicles (77) that entered the repair program failed the emissions portion of the Smog Check inspection, while 80 failed for reasons other than the emissions test. Thirty-eight percent of the vehicles that failed the emissions portion of the initial Smog Check inspection were classified as gross polluters according to Smog Check emissions criteria. The average repair cost for the vehicles that failed the emissions test was \$576, and those vehicles' CO, HC, and NO_x emissions were reduced by 91, 77, and 81%, respectively. For the remaining 80 vehicles that failed the Smog Check inspection but did not fail for emissions, their average repair cost was \$519. For those 80 vehicles, CO, HC, and NO_x emissions decreased by 31, 48, and 47%, respectively, after repairs. Although those 80 vehicles were successfully repaired according to Smog Check criteria, their emission reductions were small when compared with those that failed the emissions portion of the Smog Check inspection before repairs.

The owners of 86 participating vehicles chose not to have their vehicles completely repaired according to Smog Check inspection criteria for a variety of reasons. The average pre-repair emissions were generally highest for this group of vehicles, so a significant emissions benefit was lost from those vehicles. Thirty-one, or 10% of the vehicles that failed the emissions and visual inspection on the day of the TI&TU event that entered the repair program, passed the Smog Check inspection at the repair shops.

Large emission reductions were obtained from the effectively-repaired 77 vehicles that failed the emissions portion of the Smog Check inspection; their emission reductions were larger than those obtained from repaired vehicles in the 1995 California I/M Pilot Program. If each of these vehicles was driven 10,000 miles per year and the repairs lasted for 10,000 miles, each vehicle's emissions would be reduced by a total of 486, 46, and 29 pounds per year of CO, HC, and NO_x, respectively. In a one-year period, the 77 successfully-repaired vehicles' emissions would be reduced by 19, 1.8, and 1.1 tons of CO, HC, and NO_x, respectively.

The cost-effectiveness of the 77 successfully-repaired vehicles in the Bakersfield Tune In & Tune Up Program was \$2,054 per ton for the sum of carbon monoxide, exhaust hydrocarbons, and nitrogen oxide emissions. For exhaust hydrocarbons and nitrogen oxides combined, the cost of emission reductions was \$15,425 per ton. These are upper-limit values, because reductions of evaporative or nontailpipe hydrocarbon and particulate matter emissions obtained by performing Smog Check repairs were not measured in this program. Significant additional benefits would have been obtained if all participating vehicles had been completely repaired.

ACKNOWLEDGMENTS

The Valley CAN Program provided strategic, logistical and financial support of the Bakersfield Tune In & Tune Up event. We thank the California Department of Consumer Affairs/Bureau of Automotive Repair staff who provided on-site support by administering the emissions test used to identify high-emitting vehicles in this study, Roger Teschner from the Advanced Transportation Technology and Energy Initiative (ATTEi) at Fresno City College, and the automotive students and instructors from Bakersfield City College. We acknowledge Mary Teschner for creating the databases for the vehicles that participated in the Bakersfield TI&TU event and Emily Wimberger and Cynthia Stover who were instrumental in providing key data. The certified Gold Shield repair shops that participated in the 2009 Bakersfield TI&TU event were Rosedale Automotive, Superior Automotive Services, and Wheels Automotive Repair and Smog.